Before the

FEDERAL COMMUNICATIONS COMMISSION

Washington, D.C. 20554

In the Matter of	)	
	)	
Additional Comment Sought on Public Safety,	)	GN Docket Nos. 09-47,09-51, 09-137
Homeland Security, and Cybersecurity	)	PS Docket Nos. 06-229, 07-100, 07-114
Elements of National Broadband Plan	)	WT Docket No. 06-150
NBP Public Notice # 8	)	CC Docket No. 94-102
	)	WC Docket No. 05-196
	)	
	)	
	)	

COMMENTS OF THE CITY OF NEW YORK

The City of New York ("City") appreciates the opportunity to submit the following comments in response to questions put forth by the Federal Communications Commission ("FCC" or "Commission") in connection with its efforts to better quantify the specialized wireless broadband requirements of current and future public safety users, and the necessary actions, through the Commission's Rulemaking process, to ensure interoperability and robustness for a nationwide mobile wireless network. Public safety agencies are tasked with greater responsibilities than ever before due to the threat of terrorism. First Responders have assumed many new roles because of the serious nature of the threats to our nation and having to protect against more sophisticated weapons. Technology has provided new and more efficient methods to gather and analyze information; however, that information cannot be disseminated efficiently to the firefighters, police officers and emergency medical service technicians who are our first line of defense. Technology has outgrown our current methods of transport, and it is clear to the public safety community that there is an immediate need to utilize the same types of technologies that have been available to the public for many years. Having no other option, public safety has been forced to use commercial services to supplement their existing low-bandwidth private data systems with very limited success. However, commercial services have not been incentivized to build public safety grade networks, as the return on investment is apparently not in line with their business models. Providing the levels of redundancy and resiliency that are required for mission critical communications is costly and complex, and, therefore, often better addressed by government-owned networks. This does not preclude the use of commercial networks by government and public safety, but limits their value when critical communications are an absolute requirement.

The information and models submitted in these Comments identify New York City's current and future broadband requirements support the need for Commission action on the City's June 2009 petition.[1] We illustrate the need to resolve the 700MHz matter both swiftly and with certainty so that public safety agencies with the most pressing needs can begin developing broadband mobile wireless networks and continue to protect the citizens we serve.

[1] Request by the City of New York for Waiver of the Commission's Rules to Deploy a Public Safety Interoperable Broadband Network in the 700 MHz Band, WT Docket No. 06-150, PS Docket No. 06-229 (filed June 8, 2009).

1. City of New York's Public Safety Use of Wireless Broadband Networks: New York City Wireless Network ("NYCWiN")

The New York City Broadband Wireless Network, ("NYCWiN") became operational in all five boroughs as of April 2009. NYCWiN is a public safety wireless broadband data network operating on 10MHz of leased spectrum in the 2.5GHz band. NYCWiN is reserved for municipal use only, and provides the ability for public safety agencies to use the system in parallel with other municipal government users. The network was designed to serve all government users but in the event of an emergency, public safety users command priority access to the network through pre-determined Quality of Service (QOS) factors. NYCWiN employs Universal Mobile Telecommunications System (UMTS) – Time-Division Duplexing (TDD) cellular technology, an internationally available, open standard TD-CDMA technology that emphasizes high-speed mobile applications.

NYCWiN is designed to be first and foremost a public safety broadband data network to support the "on-street" requirements of the City's First Responders and public service agencies. Deployed consistent with public safety standards, it provides a resilient network capable of delivering real-time information to the field. The network is comprised of approximately 400 sites, with a sophisticated backhaul transport network that is redundant with path diversity. NYCWiN maintains two Network Operations Centers ("NOCs") staffed 24 hours per day, 7 days per week to maintain and support the equipment and users. Each site is equipped with a minimum of 24 hours of battery backup power monitored by the NOCs. The City's public safety agencies have begun implementing myriad applications and uses of the network that are meeting critical communications needs and improving the way they do business.

2. New York Police Department Uses of NYCWiN

The New York City Police Department ("NYPD") has adopted NYCWiN as its primary data network, and is presently deploying equipment and applications throughout the agency. Specialized units are currently using NYCWiN to transmit and view video during major incidents and operations, and intend to expand their use of the network for video distribution in the near future. The Emergency Services Unit uses the network to monitor and query the NYPD's Computer Aided Dispatch system to improve its response times and to provide pre-arrival information that was previously constrained by the limitations of voice radio traffic only. The officers also have access to secure databases that contain critical response and mitigation information. Incident video is also available through an interoperable video sharing application that provides real-time feeds from traffic, tactical, and news cameras. The NYPD is also planning to expand the video distribution network to include mobile command posts and other police command vehicles to improve situational awareness and incident management. The City has started the installation of 1,500 new mobile data computers and NYCWiN modems. The laptops will be deployed with software that will allow patrol and supervisory officers to access legacy and recently developed applications designed to take advantage of the broadband network. NYCWiN allows the NYPD to access applications and information that is not available over its existing narrowband data network. Police officers will have access to the NYPD intranet, photo and records databases, Real-Time Crime Center information and other high-bandwidth applications.

3. Fire Department of New York Uses of NYCWiN

The Fire Department ("FDNY") immediately began using NYCWiN for tactical video transmission from incident scenes. Specifically, NYCWiN allows the FDNY to deploy video cameras on their Command Tactical and Field Communications vehicles which can be dispatched to the scene of a major incident and transmit streaming video to their Operations Center and other specialized units. The network is also used to distribute fire-ground audio from the scene to its Operations Center and responding supervisors. Prior to the completion of NYCWiN fire-ground audio was limited to first responders at the scene. Modems are being integrated into the FDNY's Electronic Command Boards to connect these portable command posts to legacy and new applications allowing for real-time exchange of critical incident information. The FDNY's Emergency Medical Services ("EMS") Command integrated an Automated Vehicle Location (AVL) application into its ambulances to improve response times and provide enhanced situational awareness. The limited capacity of its legacy data networks restricts the ability of their applications and systems to work to their fullest potential. EMS is currently in the planning phase for the installation of NYCWiN modems in their vehicles to allow for the use of more data rich applications such as mobile mapping, medical telemetry and in-vehicle computer based training. All of these new applications require considerably more bandwidth than is available from their present narrowband systems.

4. Office of Emergency Management Uses of NYCWiN

The City's Office of Emergency Management ("OEM") presently uses the network to view and transmit video from incident scenes, access its intranet and manage the various resources that fall under their authority. NYCWiN has enabled OEM to utilize its Geographic Information System ("GIS") based incident management system to coordinate agency response to critical incidents, allowing OEM to be more productive in the field, and to improve information access and distribution. OEM was an "early adopter" of NYCWiN, and is currently preparing for the next phase of applications rollout, which will include enhanced video distribution, integration with the City's Incident Management System and critical executive and incident based inter-agency level video conferencing.

5. Current and Anticipated Needs of the Public Safety Community for Mobile Wireless Broadband Networks and Applications

The City is closely monitoring the progression of Long Term Evolution ("LTE") technology as it relates to both mission critical data and voice applications, including duplex phone calls, push to talk, instant messaging and broadcast video. Broadband technologies are developing at a rapid pace and the possibility of LTE supporting "push-to-talk" voice communications must be investigated as an alternative to narrowband technology. The lessons to be learned from past experience is that increasing channel size (broad-banding) rather than reducing channel size (narrow-banding) leads to more efficient use of scarce spectral resources. The City understands that the LTE standards for voice have not been fully developed and that initial forays into broadband voice communications may be a few years away. However, the Commission should act now to ensure that sufficient spectrum is available and that public safety standards are developed for the technology ultimately to support the needs of emergency responders.

6. Anticipated Broadband Traffic and Capacity Requirements

Using New York City's experience in building NYCWiN as a basis for analysis, New York City has examined the impact that broadband systems may have in the future operations of the public safety. We have collected relevant data points by gathering application usage from NYCWiN as a means of providing real-world operational and performance data for the Commission's deliberations on broadband usage. First, NYCWiN's 2.5 GHz broadband system provided a basis to characterize the various types of broadband applications that are in use today by the New York City public safety and public sector users. These applications and associated data rates are seen in table 1 below.

Data Rates	Download (Kbps)	Upload (kbps)
Incident Video upload	12	647
AVL Monitoring	51	4
Website Viewing	90	5
SFTP Transfer	93	92
Field Video Viewing	1150	28
Mobile Audio & Video upload	19	96

Table 1 - Typical Data Rates Derived from NYCWiN

The analysis focuses on two very important areas of consideration necessary in understanding the future needs for spectrum for New York City. First we examined the impact of secure broadband applications and the relation to bandwidth to support these applications. As has been discussed throughout the proceeding in relation to the 700

MHz spectrum, public safety has a critical need to improve daily operations through the use of both mobile and fixed applications and technology.

However, it is important to understand that public safety systems must be designed to function at a higher level than the accepted norm for everyday operations to grasp the bandwidth requirements for first responders. As we have seen many times, commercial systems have shown the greatest amount of stress during major City disasters and special events, including:

- September 11th attacks in New York and the Pentagon
- American Airlines Flight 587: November 12, 2001
- Staten Island Refinery Explosions: February 21, 2003
- Staten Island Ferry Crash: October 15, 2003
- Midtown Building Collapse: July 10, 2006
- Cory Lidle Plane Crash: October 11, 2006
- Midtown Steam Pipe Explosion: July 18, 2007
- Multiple Crane Collapses: March and May 2008
- Miracle on the Hudson: January 15, 2009
- Helicopter/Plane Crash on the Hudson August 8, 2009
- Annual and Special Events (i.e. Republican National Convention: August 24-September 2, 2004; Giants' Super Bowl parade: February 5, 2008;Yankees' World Series parade: November 6, 2009; and annual United Nations-related events)

In virtually every one of these instances the commercial networks were overloaded, rendering the networks in the vicinity virtually unusable. In certain cases, the networks were also rendered inoperable due to the lack of sufficient battery back-up or emergency power. These, as well as other real life examples, demonstrate that commercial networks are not designed to function under the stress of critical incidents and when needed the most, cannot perform as required.

First responder and emergency services require significantly more bandwidth and robust functional capabilities than is presently afforded by the 10MHz allocation to public safety in the 763-768/793-798 MHz band segment. The City also believes that the most effective approach to a broadband public safety network necessitates the allocation of sufficient spectrum to satisfy current and future needs of First Responders.

7. Normal Operations Scenario

Using real data derived from our analysis of NYCWiN applications, and extrapolating the projected target numbers for the desired adoption of a broadband network by public safety users in New York City, we examined the impact over time for system bandwidth usage as compared to available system capacity. The analysis employs models that are similar to in structure those models used by commercial broadband providers in evaluating their capacity needs, but included assumptions appropriate for public safety usage. We have defined four classes of applications: vehicle Mobile Data Terminal ("MDT") installations; Automated License Plate Recognition ("ALPR"); mission critical video; and personal handheld devices. The model assumes a conservative 5% per year increase in the per user bandwidth requirement for both the MDT and handheld devices based on current trends in technology growth and additional system capabilities.

Commercial networks generally use a 5% to 10% available user to active user ratio. In simple terms, at 5% usage the assumption is that 1 out of 20 users will be using the system at any one time. For the public safety environment we determined that the commercial carrier formula is not applicable due to several factors. We must assume that these devices are used in the day-to-day operations of a majority of system users and are typically reused by each on-duty shift. The number is not likely to be applicable in heavy daytime operation hours for operational vehicles and handheld personal devices. Additionally, the commercial carrier assumption of 5% to 10% of registered users cannot be applied during events such as emergencies, special events, demonstrations and other large deployments of public safety personnel. As such, a 25% available to active ratio was used for mobile data terminals in vehicles and a 100% ratio was used for machine-to-machine users such as license plate readers.

8. Normal Operations Model

Using a simple model based on accepted commercial analysis techniques, we examined scenarios that consider the impact of a 12 year program maturation period for a secure broadband network deployed in New York City at 700 MHz. The model network deployment assumes a street-level coverage design comparable to NYCWiN for the City's five 5 boroughs, and uses the known capacity and bandwidth performance of LTE standard equipment as of this writing. The demand model starts with 1,000 vehicle deployments, 40 LPR units, 100 mobile video assets, and 1,000 mobile handheld users. Over the 12 year period, the users adopt the network using an "s-curve" model to a final count of 10,000 vehicles, 1,200 LPR units, 2,000 video assets, and 25,000 mobile handheld users. These "counts" are derived from a conservative analysis of anticipated user demand for a secure network of this type by public safety users in New York City. (However, the potential, if expanded beyond local jurisdictions to state and federal entities, could easily exceed 100,000 end user devices.)

The demand model was evaluated with reference to the different levels of aggregate capacity that would be available based on different amounts of spectrum. In the case of a 10 MHz spectrum allocation, as illustrated by the graph in Figure 2, the conservative adoption of a 700 MHz network by agencies would result in the upload ("UL") demand reaching 75% in year 5 and 100% in year 6; while the download ("DL") demand reaches 75% in year 7 and 100% in year 9. The model uses very conservative usage assumptions and bandwidth per user requirements and it is anticipated that it is likely these estimates may be low as secure broadband data access becomes an integral part of everyday operations. The commercial industry equivalent to the plausible underestimation of usage comes in the form of the stress placed on commercial carrier networks by smart phones like the Apple iPhone. These phones have placed significant stress on the capacity of commercial network data services because of the accelerated adoption of new applications and utilization of bandwidth for these new applications.

The 20 MHz LTE analysis uses the same demand assumptions but increases the available aggregate bandwidth as a result of increasing the spectrum available to the Public Safety network from 10 MHz to 20 MHz. The analysis found that the uplink capacity of the network still reaches the 75% at year 8 but never reaches the 100% mark over the 12 year period. The DL system capacity stays below 75% over the entire period of the 12 years, but it does reach a level of >50% as early as 7 years. <u>It is important to note that just a single major incident will require bandwidth well beyond the everyday</u>

operational capacity of the network and sufficient reserve bandwidth must be available to ensure proper operational support during a major incident. We have included a parallel analysis of a major incident in figures 3 and 4 on the following pages.

10 MHz LTE Model

Technology	LTE - 10 MHz						
DL Capacity (Mbps)	10						
UL Capacity (Mbps)	3						
Start Year	1						
End Year	12						
User Categories	Initial Number	Final Number	Duty Cycle	DL Data Rate (Mbps)	UL Data Rate (Mbps)	Growth Pattern	Yearly Increase Demand
Vehicles	1000	10000	25%	1	0.25	S-Curve	5%
LPR	40	1200	100%	0.012	0.25	S-Curve	0%
Video Cameras	100	2000	100%	0.012	0.65	S-Curve	0%
Handhelds	1000	25000	5%	1	0.25	S-Curve	5%
# of Sites	200						
Cells/sector	3						

Figure 1 - 10 MHz LTE Model Inputs

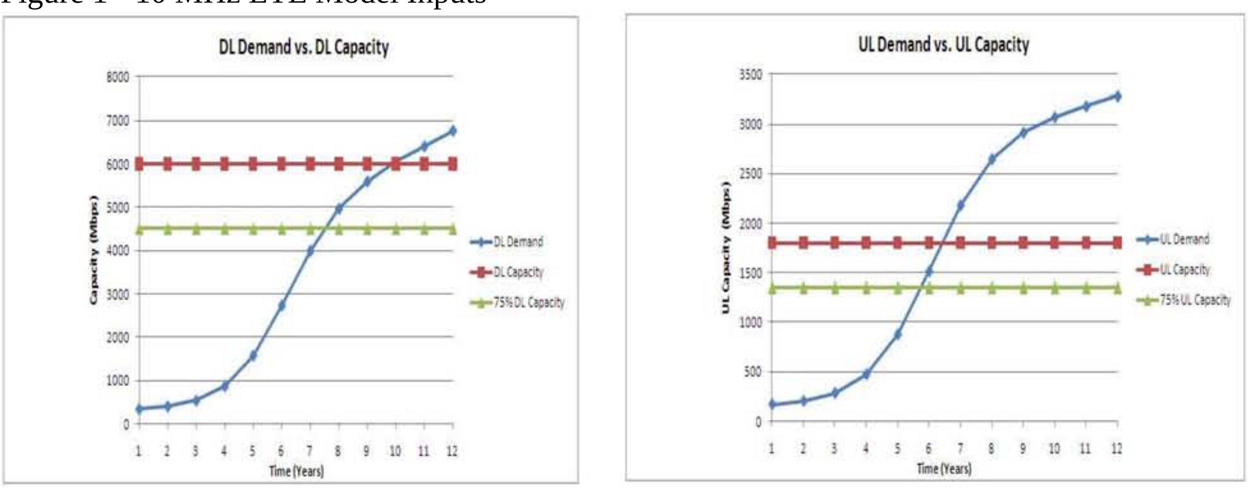

Figure 2 - 10 MHz LTE Capacity Model Graphs

20 MHz LTE

Technology	LTE - 20 MHz						
DL Capacity (Mbps)	21						
UL Capacity (Mbps)	6						
Start Year	1						
End Year	12						
User Categories	Initial Number	Final Number	Duty Cycle	DL Data Rate (Mbps)	UL Data Rate (Mbps)	Growth Pattern	Yearly Increase Demand
Vehicles	1000	10000	25%	1	0.25	S-Curve	5%
LPR	40	1200	100%	0.012	0.25	S-Curve	0%
Video Cameras	100	2000	100%	0.012	0.65	S-Curve	0%
Handhelds	1000	25000	5%	1	0.25	S-Curve	5%
# of Sites	200						
Cells/sector	3						

Figure 3 - 20 MHz LTE Model Inputs

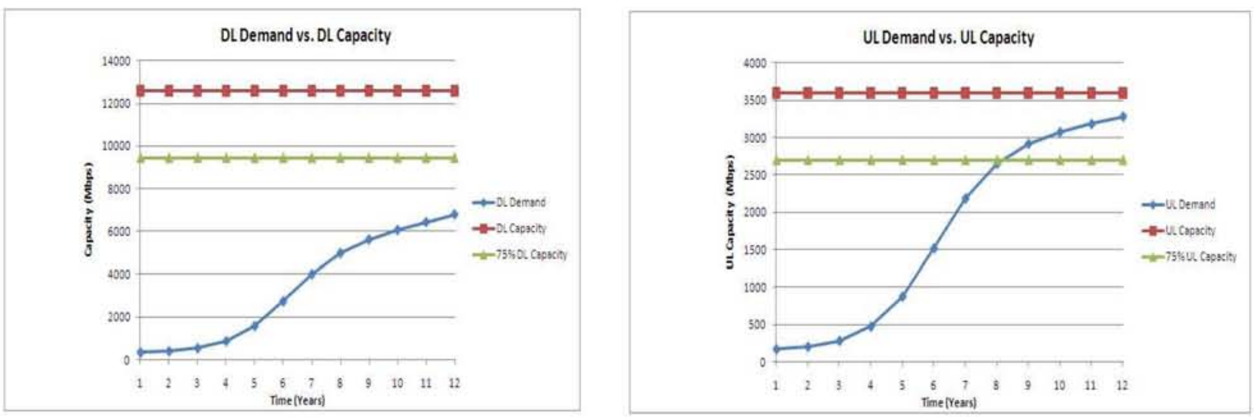

Figure 4 - 20 MHz LTE Capacity Model Graphs

9. Normal Operations with Voice Application

While the previous section considered only data applications to estimate the total bandwidth demand, in this section we add mobile, enterprise-class Voice as an application and analyzed its impact on overall bandwidth demand. (As standards have yet to be defined for mission critical voice for LTE, we have focused this analysis on non-mission critical use for which reasonable bandwidth estimates can be made.) We start with 1,000 voice users increasing to 25,000 users at the end of 12 year program maturity period. Voice is a relatively low bandwidth application requiring only about 25 Kbps of bandwidth on both the downlink and the uplink. Current industry estimates of LTE voice capacity are ~160 and ~ 320 simultaneous voice calls in 10 MHz and 20 MHz bandwidth respectively, assuming the entire capacity is dedicated to voice. Under the current assumption of a street-level coverage design of 200, 3-sectored sites, this translates to ~96,000 and ~192,000 total voice users in 10 MHz and 20 MHz bandwidth respectively. Our assumption of maximum of 25,000 users accounts for only ~26% (~13%) of the total voice capacity if all the 10 MHz (20 MHz) capacity were to be dedicated for voice use. This shows that with the number of assumed voice users, there is still considerable capacity available in the network for other data applications. The charts below show the total demand, including voice, versus available capacity in the network for the two cases of 10 MHz and 20 MHz of bandwidth.

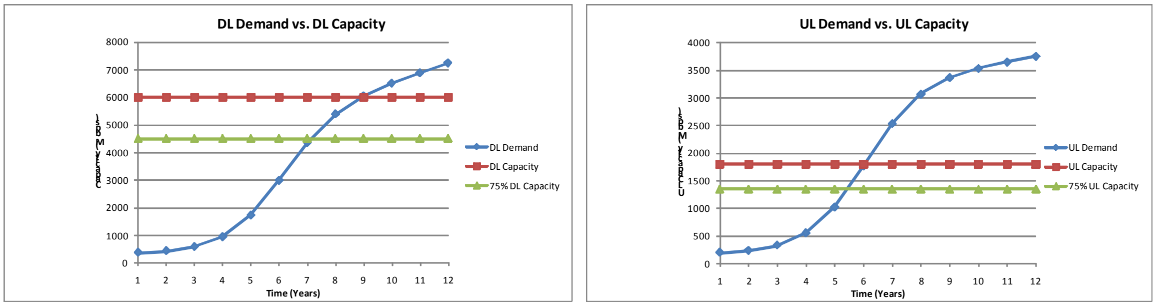

Figure 5- 10 MHz LTE Model Capacity Graphs with Voice

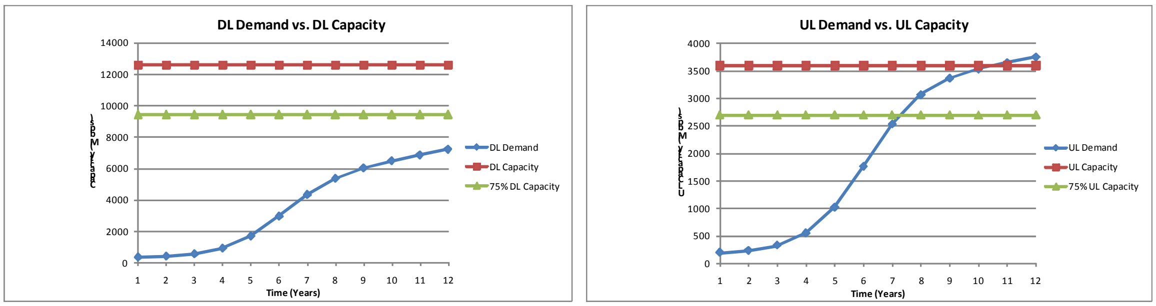

Figure 6- 20 MHz LTE Model Capacity Graphs with Voice

Comparing these charts with the case without voice, we notice a small impact on capacity. For the 10 MHz case, threshold of 75% downlink capacity is exceeded at the end of year 7 instead of year 7.5 without voice, The Tables below illustrates the capacity impact of adding voice for both the 10 MHz and the 20 MHz cases.

75% Capacity Exceeded	With Voice	Without Voice
Downlink	7 years	7.5 years
Uplink	5.5 years	5.8 years

Table 2 - Capacity with and without Voice with 10 MHz LTE Bandwidth

75% Capacity Exceeded	With Voice	Without Voice
Downlink	> 12 years	>12 years
Uplink	7.1 years	8 years

Table 3 - Capacity with and without Voice with 20 MHz LTE Bandwidth

Although the impact of adding voice to the overall capacity is small, this is true only for the number of voice users assumed in this model. If the number of users becomes significantly higher, that would result in a considerable impact on available capacity. Likewise, the model does not take into account the potential impacts on data traffic associated with the yet-to-be-defined implementation of VoIP on LTE. If, for example, the real time nature of VoIP traffic is supported by dedicated channels or bandwidth, the effective bandwidth available to other data traffic could be reduced beyond the linear model assumed in this analysis.

10. Critical Incident Bandwidth Requirements

While a public safety broadband wireless network provides valuable services to the public safety personnel in the execution of their day-to-day operations, the potential of a broadband network is truly and fully realized only during an emergency incident brought about by a natural or man-made disaster. Public safety networks must be designed and built to meet the most stringent requirements for reliability, availability, quality of service, and security. An important aspect of public safety broadband networks that requires careful consideration is their engineered capacity, and that is strictly a function of the total amount of spectrum available for public safety use. Although the networks can be engineered and hardened to highest standards of reliability and availability, that is meaningful only if there is enough capacity available in the sites serving an incident scene to meet the communication requirements of hundreds, if not thousands, of first responders. A capacity shortfall during a major incident scene would result in blocked and delayed calls, significantly hampering the efforts of public safety personnel to save and protect lives and property. Since an incident can strike without warning at anytime and anywhere in the jurisdictional area of a network, it is imperative that all the sites in the network be provisioned with enough capacity to handle the worst case scenario that would unfold during an emergency situation.

We must assume that a major incident such as the September 11th terrorist attacks on the World Trade Center, if such an incident were to occur again, will require a large and coordinated response by federal, state and local public safety First Responders and support personnel. The purpose of the National Broadband Network is to provide high-speed interoperable data and voice communications for First Responders. The network, under normal circumstances, will be used by the local or regional agencies to conduct day-to-day operations in the conduct of their public safety mission. However, should another terrorist attack of similar proportion occur there will be a large scale response from federal, state and local jurisdictions into the incident area. In the future, when the regional segments of the network are built-out, First Responders and support personnel will be using the network while en-route to the incident and upon arrival at the scene. Because of the dense urban and suburban populations of the greater metropolitan areas there are upwards of 50,000 state and local public safety First Responders in the immediate New York City metropolitan area. In addition, there are many federal agencies that maintain personnel in the area that could potentially respond to a major incident. It is conceivable that the number of active users could increase by approximately 75% if a large response is required.

11. New York City Critical Incident Response Simulation

In the following section we describe a hypothetical incident scene in the New York City with the specific objective of estimating how much spectrum is required to adequately meet the communications requirements of First Responder emergency operations.

The incident involves a “dirty bomb” set-off at Pennsylvania Station in Midtown Manhattan. The device was planted in the information and ticket sales area of the Amtrak area and has caused moderate structural damage to the area and has caused secondary damage to the structure above and below Amtrak’s Penn Station. The area below the Amtrak section is part of the Long Island Rail Road (“LIRR”) complex, and has damaged passenger corridors and waiting areas. The bomb has also damaged the structure above the Amtrak waiting area, which is part of the Penn Plaza/Madison Square Garden complex. Immediately above Pennsylvania Station is a large office building that is operating at 75% occupancy.

The “dirty bomb” has released nuclear contaminants throughout the Amtrak and LIRR complexes and into the areas above and below the stations. The bomb also caused fires to break out on all levels including the track levels. The fires are causing a large smoke condition throughout the complex and into the track areas of the LIRR, Amtrak New Jersey Transit, and the New York City Subway. Smoke is also billowing out of the station at the street level exits and blanketing the street area immediately around Penn Station.

12. Incident Assessment

There are approximately 400 injured passengers on the Amtrak / New Jersey Transit level and 500 injured passengers on the LIRR level. The injuries range from critical and serious near the center of the explosion to minor caused by fleeing passengers and the heavy smoke conditions. There are injuries on three levels of the station and above the station from falling glass and building materials.

The New NYPD has initiated a Level 4 mobilization, setting up command posts in the vicinity of 34th Street and 8th Avenue. The FDNY's Command Tactical Vehicle, Mobile Field Communications, and Emergency Medical Field Units are set in the same area. OEM has set-up their command vehicle on 8th Avenue near 34th Street. All of the mobile command posts are near each other.

FDNY is setting up a hazardous material (HazMat) detoxification / wash-down area on 31st Street and Broadway, while EMS has set up its mobile triage vehicles on 31st Street and Broadway.

The Departments of Health and Mental Hygiene and Environmental Protection have responded with their mobile command posts and have placed them in the vicinity of 35th St. and 7th 8th Ave. FDNY will use 34th St. and 8th Avenue for ambulance and bus staging and the NYPD has closed off Broadway, Seventh and Eighth avenues from 20th St. to 42nd St.

New York City Transit has been asked to stage busses to begin transporting the injured to area hospitals and has responded with a mobile command center located near the OEM command vehicle.

13. Emergency Response

Because of city's preparedness to handle incidents of this magnitude, there is a swift and coordinated response from a number of different agencies including NYPD, FDNY, EMS, and OEM, among many others. Each agency, in turn, will respond with several different units trained, equipped, and specialized in handling specific aspects of emergency response. For example, in this particular incident, NYPD will respond with, in addition to patrol vehicles, a number of different specialized units such as Detective Bureau, Intelligence Division, and Mobile Command Posts etc. Table 4 below illustrates the level of effort required to handle a crisis of this magnitude. For each of the major agencies, it lists the different units, the number of units that would be converging at the scene, and typical applications they would be using.

Table 4 - Agency Response

Police Department			
Agency	Qty	Primary Application	Secondary
NYPD Mobile Command Posts Borough and Comm. Div.	2	Requires video from deployed cameras as well as the ability to view video from other sources. Each MCP will deploy a number of wireless cameras and monitor other feeds from other MCPs and agencies. Assume each MCP has 4 cameras	Incident Management, CAD, Internet and mobile data access VoIP Comms
NYPD Emergency Services Command Posts	2	Viewing video from other sources and their own equipment. Assume each vehicle deploys 2 cameras	Incident Management, CAD, Internet and mobile data access VoIP Comms
NYPD TARU Skywatch with 4 cameras each	3	Extensive use of video and specialized equipment.	Incident Management, CAD, Internet and mobile data access VoIP Comms
NYPD CTD Command Vehicle	1	Video feeds, primarily viewing not sending Management of sensors and access to CTD databases and internet. Access to federal databases and applications. Use of portable sensors for CBRNE	Incident Management, CAD, Internet and mobile data access VoIP Comms
NYPD CTD Support Vehicles	5	MDSL deployed for mobile detection of CBRNE threats	
Portable Sensors	25	Monitors the levels of toxins and radiation, CBRNE	
Patrol Division	3	Video, access to personnel information,	Internet, VoIP

Mobile Command and Support Vehicles		databases, CAD, Incident Management	Comms, mobile data
NYPD Intel Division Mobile Support Vehicles	2	Access to databases, federal databases, internet, video feeds	Incident Management, CAD, Internet and mobile data access VoIP Comms
NYPD Fleet Services Towing Services	25	AVL	
Fire Department – Includes Emergency Medical			
Agency	Qty	Primary Application	Secondary
FDNY Command Tactical Vehicles	2	Video from CTV and portable cameras, access to FD Operations Center applications, Electronic Command Board, HAZMAT databases	Incident Management, CAD, Internet and mobile data access VoIP Comms
FDNY Field Communications (Includes Command Post)	3	Audio feeds for recording Fireground, video, uplink Fireground to FDOC	Incident Management, CAD, Internet and mobile data access VoIP Comms
FDNY Heavy Rescue	4	Video, Incident Management, CAD	
FDNY Emergency Medical Command Post	1	Video, audio from Fireground	
FDNY Mobile Triage Vehicles	3	Telemetry, video, photos,	Incident Management, CAD, Internet and mobile data access VoIP Comms
FDNY Ambulances	10	AVL, telemetry, CAD, triage applications	Incident Management, CAD, Internet and mobile data access
Office of Emergency Management			
Agency	Qty	Primary Application	Secondary
OEM Mobile Operations Center	1	Video, downlink and uplink for 5 cameras	Incident Management, CAD, Internet

			and mobile data access VoIP Comms
OEM Temporary Field Operations	1	Connectivity to OEM Operations, databases and applications	Incident Management, CAD, Internet and mobile data access VoIP Comms
Other New York City Agencies			
Agency	Qty	Primary Application	Secondary
Department of Environmental Protection Mobile Operations Center	1	Access to applications, sensors, video	
Department of Health	1	Access to applications, sensors, video	
Department of Buildings	1	Access to applications, video	
NYCT	1	Radio communications, applications	
MTA Police Field Communications Emergency Services	3	Video, applications, databases, internet	
AMTRAK Command Post	1	Video, applications, databases, internet	

14. Bandwidth Requirements Analysis

We used the model of the expected users, command vehicles and associated applications associated with the response to estimate the total bandwidth demands that would be required during the peak response periods following the incident. We have assumed that the incident area is served by a public safety broadband wireless network that is built using fourth generation Long Term Evolution (LTE) technology and operates in the 700 MHz public safety frequency band.

Table 5, below, lists the average capacities available from a single LTE sector using 10 and 20 MHz of spectrum.

Spectrum	Downlink Capacity	Uplink Capacity
10 MHz, (5 MHz Downlink, 5 MHz Uplink)	10 Mbps per sector	3 Mbps per sector
20 MHz, (10 MHz Downlink, 10 MHz Uplink)	21 Mbps per sector	6 Mbps per sector

Table 5 - Spectrum versus Capacity

The aggregate bandwidth requirements of the applications used during the incident can be compared against the available capacity. Estimated bandwidth requirements of typical applications used during at an emergency incident are listed in Table 6.

Application	Downlink Data Rates (Kbps)	Uplink Data Rates (Kbps)
Incident Video Upload	12	647
Field Video	1150	28
Data Access	10	100
CAD Dispatch	50 Kbps	50 Kbps
VoIP	25 Kbps	25 Kbps

Table 6 - Application Data Rates

As illustrated in Table 6, video applications are the most demanding in terms of bandwidth usage. However, this is a critical application for incident management, sending images in real-time from the incident scene to the command and control centers, enhancing situational awareness, and providing a current and consistent "operating picture" to support an effective and a coordinated response. An incident scene will typically have a large number of video cameras streaming information back to the command vehicles present at the scene as well as to the central command and control centers. Command staff personnel from each agency will make extensive use of the video feeds to get a real-time view of rapidly and dynamically changing situation at the incident scene to aid them in their decision making process and to coordinate their response with other agencies.

In the incident scene we have depicted there are 38 simultaneous downlink video streams consuming about 44 Mbps of bandwidth at 1.15 Mbps per video stream. These streams are distributed to the various public safety command vehicles present at the scene. This combined with other applications such as database access, file downloads, telemetry, computer aided dispatch, VoIP results in an aggregate sustained downlink bandwidth requirement of about 60 Mbps.

On the UL, we have assumed that the agencies will deploy twelve portable or vehicle mounted cameras continuously sending real time images from the incident scene. This utilizes about 9 Mbps of bandwidth on the UL. Another significant consumer of uplink bandwidth is ambulances sending triage images back to the hospitals to inform them in advance of the nature and seriousness of the injuries. We estimate that EMS will utilize about 2 Mbps of uplink bandwidth. Coupled with UL usage of other applications, aggregate bandwidth used on the uplink is about 16 Mbps.

The aggregate bandwidth demands in above can be compared against the bandwidth that would be available in an incident scene. Available bandwidth is a function of the number of sectors/sites that would be within range of the incident scene and bandwidth available per sector, as shown in Table 5. Table 7 shows the total aggregate demand at the incident scene and the number of sectors of bandwidth that would be required to fulfill that demand.

Spectrum	Downlink Demand	LTE Sectors Required for DL Demand	Uplink Demand	LTE Sectors Required for UL Demand

10 MHz (5 MHz uplink) (5 MHz downlink)	60 Mbps	6	16 Mbps	6
20 MHz (10 MHz uplink) (10 MHz downlink)	60 Mbps	3	16 Mbps	3

Table 7 - Total Incident Scene Demand

The number of sites that would realistically available to support an incident is a function of the network design and the geographic distribution of the users. In the example provided, given the localized nature of the incident coupled with lower site count due to superior propagation characteristics of the 700 MHz frequency band relative to other higher frequencies such as 2.5 GHz and 1.9 GHz, it is likely that the incident scene would be served by only 3 sectors.

For incident scenario presented and the associated site density, 10 MHz of spectrum will fall considerably short of the required bandwidth demand. Indeed, 20 MHz of spectrum is barely sufficient to meet the projected demand. We recognize that the incident we have utilized in our model represents a severe case. Unfortunately, however, it is within the realm of possible threats for a large metropolitan city like New York. To meet the extraordinary demands that are placed on a network during emergency situations, we strongly believe that 20 MHz of spectrum is needed in order to prevent the network from being saturated and to continue providing reliable service.

Incident Scene Operations

Incident Response Units At the Scene	Qty	Primary Application	Secondary Application	DL Data Rates Kbps
Mobile Command Posts	2	Receive 4 video feeds	CAD, internet, incident mgmt, VoIP	9700
Emergency Service Unit (ESU)	2	Receive 2 video feeds	CAD, internet, incident mgmt, VoIP	5100
Technical Advisory Response Unit (TARU)	3	Uploading 4 video streams	CAD, internet, incident mgmt, VoIP	642
Counter Terrorism Department (CTD) command vehicle	1	Receiving 2 video feeds	CAD, internet, incident mgmt, VoIP	2550
Counter Terrorism Department (CTD) support vehicles	5	Monitor CBRNE threats		500
Portable sensors	25	CBRNE		
Patrol Division Mobile Command and Support Vehicles	3	Video, database access, internet	Internet, VoIP, comms, mobile data	4200
NYPD Intel Division Mobile support vehicles	2	Video, database access, internet	CAD, internet, incident mgmt, VoIP	2800
NYPD Fleet Services Towing Services	25	AVL		
FDNY Command Tactical Vehicles	2	Video, ECB, HAZMAT database	CAD, internet, incident mgmt, VoIP	5100
FDNY Field Communications	3	Video, Audio	CAD, internet, incident mgmt, VoIP	4200
FDNY Heavy rescue	4	Video, Incident mgmt, CAD		5600
FDNY Emergency Medical Command Post	1	Video, audio		1400
FDNY Mobile Triage Vehicles	3	Telemetry, video, photos	CAD, internet, incident mgmt, VoIP	4200
FDNY Ambulances	10	AVL, Telemetry, triage application	CAD, internet, incident mgmt, VoIP	2500
OEM Mobile operations Center	1	Video downlink, uplink	CAD, internet, incident mgmt, VoIP	2550
OEM Temporary Field Operations	1	database access, data apps	CAD, internet, incident mgmt, VoIP	300
Department of Environmental applications	1	video , sensors, apps		1400
Department of Health	1	video , sensors, apps		1400
Department of Buildings	1	video , apps		1400
NYCT	1	radio comms, apps		300
MTA Police Field Communications Emergency services	3	video, database, internet		4200
AMTRAK Command Post	1	video, database, internet		1400
Total				61

Table 8 Incident Scene Operations

15. City's Response to Commission Questions Regarding Operational Requirements

The FCC has suggested three categories of operational conditions relative to demand; critical, medium and low. For the purposes of this filing we will define the three categories as follows:

Critical – Network usage during a major incident(s) supporting a large scale response to a catastrophic event such as a bombing or natural disaster. This type of incident will initiate responses from local, federal and mutual aid agencies for initial response, rescue and recovery. Using prior incidents as a model the City can expect the number of first responders to grow exponentially as the incident progresses through its various stages and the network utilization to fluctuate between periods of extreme (>75%) utilization, heavy utilization (>50%) and medium utilization (<50%).

Medium – We have assumed that medium usage refers to normal operations during the primary work hours of a public safety agency such as the police department or the fire department. Based on staffing levels the time period for medium usage will span from early morning rush hour for both vehicular traffic and public transportation, through the normal and extended workday, the end of the school day and evening hours until midnight. This period of time from approximately 5:30 AM to 12:00 AM comprises the majority workload of the New York City Police Department. This model also takes into consideration typical tourist and commuter workforce traffic travelling into and out of the City proper. This model will most likely apply to FDNY, specifically with regard to emergency medical incidents responded to by EMS and FDNY personnel.

Low – We assume that the low usage period will consist of the period of time after the evening hours and prior to rush hour when staffing and equipment is deployed at lower levels. Typical public safety models assume that these hours are less busy than other periods and staff accordingly, however, the typical per unit workload may remain similar to the workload during busy periods due to reduced staffing.

During critical usage periods we anticipate that the network will first be utilized by First Responders to coordinate multi-agency response to the critical incident and exchange critical information relative to the incident response and operational plans. This may include but not be limited to:

- Incident data from 911 calls and first responders

- Information sharing for HAZMAT and environmental information
- Coordination of response for federal and mutual aid responders
- Video from fixed cameras that are adjacent to the incident
- Maps and GIS data relevant to the area
- Personnel and equipment rosters for logistics
- Building or location information
- Executive / managerial teleconferencing
- Personnel and vehicle tracking
- Incident management / situational awareness
- Mass notifications
- Traffic control and traffic advisories
- Download and consolidation of surveillance data for forensic analysis

As described earlier we believe that although the type of traffic will constantly fluctuate, the usage will remain high during the initial response period. Depending on the severity the initial response may last upwards of 7 to 10 days as the various first responders arrive at the incident scene. The type of network usage will change based on the stage of the incident response. We must assume that the network will be utilized at approximately 75% of capacity for the first stage of response. The network must support the first responders throughout the period of initial response to the incident through the remaining stages of rescue and recovery.

As evidenced during the September 11th terrorist attacks, the initial response was primarily a manpower intensive effort. Not only were commercial networks overwhelmed at all levels, their infrastructure was severely damaged and ineffective. Public safety responders did not have a broadband wireless networks to supplement the coordination of the massive response effort and relied on inefficient forms of communications for such a complex event.

It must be noted that during this type of incident the City's first responder agencies must also serve the entire City and not just the area of the incident. In a City as large as New York an incident can occur in a small area with a dense population and still only involve a small percentage of the City's area.

For "medium theater" operations we have assumed the model of normal daily operations of the City's First Responders. In this category public safety will utilize applications designed for routine business processes. The FDNY's typical usage will consist of dispatch information for fire and medical incidents that will require broadband communications to transfer patient data, location history and HAZMAT information, building plans and maps, driving directions, patient telemetry, AVL and telematics data and other incident related information. Prior to the adoption of NYCWiN, none of this information was available to responding units with the exception of on-scene patient telemetry for EMS. As the agencies begin implementing new technology the utilization demand will rise, primarily driven by many factors, including new capabilities of systems due to the availability of the broadband network and additional bandwidth requirements as more data intensive applications are implemented. For example; the ability to quickly and efficiently transmit patient data, photos and video of patients' injuries, and bio-metric information to a physician and subsequently allow the hospital staff to assist in field treatment via video teleconferencing will provide tremendous benefit to the citizen's of New York City.

The NYPD department will soon have the capability to download photos, within seconds from its criminal history databases, along with other critical information that will support the investigatory process in the field thus saving valuable processing time. The ability to scan bar-coded documents for traffic violations will not only save time and produce more accurate citations, it will also increase officer safety. Automated and bundled transactions will help officers make sound decisions and alert them of potentially dangerous conditions. These capabilities are <u>not</u> available with today's 25KHz channelized systems. Real-time data collection will create new capabilities for investigators and counter-terrorism personnel by moving data from the field to the data warehouse as fast as it is collected for critical analysis. Scanning a driver's license will provide officers with the appropriate information within a fraction of the time previously required to type or call in the information request. The database query will return a photo in addition to the standard Department of Motor Vehicle and warrant information, helping officers confirm the identity of individuals stopped for the violations. These and many more applications will make first responders more productive and effective. But these applications require an appropriate allocation of spectrum and bandwidth to perform as specified under these normal operating conditions.

Low theater operations do not necessarily reduce the bandwidth requirements due to lower staffing or reduced activity. Individual applications will still require sufficient bandwidth to operate efficiently. However, these periods of lower activity offer opportunities for agencies to update their mobile applications and equipment with security patches, new applications and data. The mobile and portable devices and applications should be afforded the same maintenance features benefits derived from a wired network or a commercial cellular network. Updates, new applications and patches should be pushed out from a central source to the edge devices to keep the users and devices in the field, rather than ferrying devices to depots for software updates. Applying the right design parameters to the network and applications will allow for the efficient maintenance of the devices, applications and data ensuring that the mobile workforce is truly mobile.

No matter how carefully bandwidth planning is done on any type of secure public safety wireless network, the network will eventually be placed in a position of stress due to a major incident or an unplanned increase in utilization. There is not enough spectrum available to provide the necessary overhead to assure that bandwidth will be available during critical incidents where users require immediate and high priority access. It must be assumed that utilization will be higher in certain operational scenarios. Once broadband data systems become widely adopted by public safety it is highly probable, based on analogies to commercial systems, public safety networks will be extremely stressed during events similar to September 11th in New York and July 7th in London. During events such as these usage will dramatically increase, and intelligent mechanisms to handle bandwidth must be in place well before the occurrence of a large scale emergency of this type.

In our bandwidth analysis of the incident scene we discussed the various impacts of applications on bandwidth availability during emergencies. It is clear from our analysis that in scenarios where 20 MHz of spectrum is available to public safety the system will be "stressed" during periods where important characteristics of a network need to exist above and beyond what is available commercially. A public safety system must have built-in mechanisms that support Quality of Service ("QoS"), prioritized by both applications (voice, video, data, etc.) and by the role of the user based on the operational command structure. Next generation wireless technologies, such as LTE, have included these mechanisms as part of their adopted standards; however, the configuration of these controls must be carefully implemented in any network supporting public safety users. It is highly unlikely that commercial carriers will break with their tradition of "best efforts" delivery and offer guaranteed message delivery and bandwidth allocation. Based on the quantity of users carriers must support, it will be difficult to provide priority services to a small number of users when the demand will be so great from the users at large.

New York City is learning valuable lessons from our implementation of the NYCWiN program on how to deploy and operate applications on a broadband network to ensure that the available bandwidth is efficiently and effectively used in high stress utilization conditions. Application planning must include such concepts as intelligent distribution of data based on role, location, and need utilizing prioritized push technologies to control of information flow during peak and stressed network conditions.

16. Device Requirements

Public safety device requirements will vary from agency to agency however the City understands that these devices must be rugged enough to withstand the rigors of first responder use. These devices must operate continuously for long periods of time. Typical public safety devices are used continuously for the duration of the shift. The same device will be returned at the end of a tour to be re-issued with a fresh battery for the oncoming shift. Although this is not the case in every public safety agency, it is common for agencies in large cities to follow this usage pattern. The devices must be built to the same specifications that are required for the City's land mobile radio equipment, typically all applicable MIL-SPEC standards. We also understand that broadband data devices have different features such as larger displays and keyboards for data entry. These devices will be as critical to the mission of the First Responder as the radio and firearm and must function reliably throughout the tour. The devices need to be portable and capable of operating under extreme conditions. This is especially critical for use by the FDNY, where the device will be exposed to extreme temperatures and water conditions. The devices must be capable of roaming into other jurisdiction's networks and supporting their associated application and security requirements. Interoperability of these devices with other networks is critical to the success of this program.

There are two overall categories of devices required by public safety: mobile and portable (i.e. handheld). Mobile devices are typically installed permanently in a vehicle and portable devices are characterized as handheld devices. Due to the versatility of a broadband network, we need to clarify the capabilities and usage of these devices. In defining mobile devices we can assume that devices and associated modems are installed in vehicles for use as a data entry and query device. However, we must include applications and capabilities that are more complex than a laptop used for digital dispatch. Broadband capabilities now encourage agencies to create mobile field offices that integrate sensors, license plate readers, in-car video systems, fingerprint capture and query, digital photography, video feeds, AVL and many other new applications. The ability to integrate these systems into a cohesive mobile environment is now enhanced by the prospect of broadband connectivity. In-car video can be transmitted to operations centers, license plate readers can capture images of plates and compare them against local or remote "hot-lists" and databases for real-time situational awareness. AVL can be integrated into the dispatch system to not only select the closest unit but also direct other specialized units based on capabilities and proximity to the incident. Device capabilities will be defined by the applications that public safety believes are necessary now and in the future.

Network requirements must include sufficient bandwidth to provide client management services for large user networks such that the devices and applications can be managed as part of the enterprise services solution. The edge devices must be considered part of the entire enterprise and managed as such. The clients must be maintained in the same secure manner as the wired client devices connected to the network. Wireless devices must be maintained over the wireless network to ensure that the devices are secure and up to date. In the current desktop environment clients are managed at the enterprise level using commercial off-the-shelf ("COTS") products to push out security patches, software upgrades, and new applications. Managing entities can schedule maintenance pushes and inventory pulls during low theater operations to ensure that the devices are secure and running the latest versions of the agency's applications.

17. Applications Catalogue

In Table 9 below we have catalogued both current and future applications that will utilize the broadband wireless network for transport. The entries in the table were derived from discussions public safety subject matter experts and technology suppliers and are meant to be generic descriptions of applications that are presently utilized, in the planning phase or for future implementation.

Table 9

Application Description	Bandwidth	Agency
Database Inquiries (DMV, warrants, location history, HazMat, etc)	Medium	PD, FD, EM, OEM
Bio-metric Identification (Mobile fingerprinting, iris & photo)	High	PD
Computer Aided Dispatch	Medium	PD, FD, EM
Next Generation 911 Support	Medium	PD, FD, EM
Next Generation Telematics	High	PD, FD, EM
Records Management	Medium	PD, FD, EM
Automated Field Reporting (includes citation)	Medium	PD,FD, EM, OEM
Automatic Vehicle Location with telematics (Fleet)	Medium	All
AVL with real-time routing and unit recommendation	Medium	All
In-car video (transmitted to operations center during emergency)	High	PD
Automated License Plate Recognition (Fixed and Mobile)	High	PD
Application Description	Bandwidth	Agency
Automated License Plate Recognition w/automated query	High	PD
Mobile Command Post Data and VoIP Communications	Medium	All
Mobile Command Post Video	High	All
Emergency Call Boxes	Low	All
Emergency Call Boxes with integrated video	High	All
Photo and video transmission for suspect information	High	PD
Gun Shot Detection	Low	PD
Gun Shot Detection with integrated video	High	PD
Fixed Wireless Video (no wired infrastructure)	High	PD, OEM
CBRNE Sensors (fixed and mobile)	Medium	PD, FD, OEM, Other
Weather Sensors	Medium	All
Video Teleconferencing (Incident Management)	High	All
Blue Force Tracking	Medium	PD

Situational Awareness (Video, data, GIS)	High	All
Access to legacy databases and applications	Medium	All
Water Quality Monitoring	Low	OEM
Plume Modeling (Bio, Rad, Smoke)	High	PD, FD, OEM
Floor plans, drawings, 3D graphical displays	High	PD, FD, OEM, Other
Traffic and Intersection Control	Medium	All
Covert surveillance audio and video	Medium	PD
Information Exchange	Medium	PD
Real-Time Crime Analysis (Data push)	Medium	PD
Firefighter Bio-metrics and vitals tracking	Medium	FD
Incident Management System	Medium	All
Patient Tracking and Information Systems	Medium	EM
Patient Medical Telemetry with audio and video	High	EM
Medical Teleconferencing (mobile, field triage)	High	EM
Covert vehicle tracking	Low	PD
Tactical Collaboration (TouchTable and other apps)	Medium	All
Emergency Operations Applications	Medium	All
Mission Critical Voice	High	All
GIS and Geo-Spatial applications for public safety	High	All
Integrated Justice/E-Justice	Medium	PD, Courts
Facial Recognition / Video Analytics	High	PD, OEM
Maritime Surveillance and Monitoring	Medium	PD, OEM, Coast Guard
Software Updates, patches and new applications Continuity of Operations (Back-up for wired networks)	Medium High	All All
Application Description	Bandwidth	Agency
Remote Site Connectivity (temporary)	Medium	All
On Scene Video Distribution (LAPD Model)	High	All

18. Network and Backhaul Requirements

Broadband networks require sufficient backhaul to support the day-to-day and critical incident volumes associated with public safety operations. We anticipate that the infrastructure, at least for New York City, will be government owned and maintained to a level comparable to the private data networks we maintain today. The City desires to build a public safety network that first and foremost will be interoperable with the national network standards to ensure roaming and data sharing across the network. The City also intends to build this network to the same public safety standards used for both voice and data networks for coverage and redundancy.

New York City public safety agencies utilize many different types of communications transport for primary and secondary backhaul transport for their critical networks. There are many types of broadband transport networks available within the City of New York including dark, franchise and private fiber, point-to-point microwave networks, leased fiber, SONET ring, and Frame Relay; all available to the agencies. Applying the same philosophy that was used to build NYCWiN, the City will use a combination of microwave; city owned fiber and leased fiber to interconnect the sites. Each site will require diverse service with at least two recoverable transport paths from secondary sites. The loss of a single path must not degrade the performance of the network. Ideally, as the City builds out its core network to include more dark fiber and microwave we will be completely reliant on City-owned transport. This approach does not rule out leasing services from commercial providers however it is the City's opinion that privately maintained transport is economically viable and more resilient. A diverse mix of the various technologies will provide the appropriate levels of redundancy that the agencies require.

19. Conclusion

The City of New York appreciates the opportunity to participate in this effort to define present and future public safety wireless broadband network requirements. We applaud the Commission's effort to act quickly and gather the information from the user vendor community. The City looks forward to participating in an ongoing dialogue with the FCC, particularly on the issues surrounding the technology, spectrum, and funding related aspects of implementing this urgently needed next generation mobile broadband public safety network. We believe that the Commission is at a critical juncture in the decision making process. There is an obvious opportunity for public safety to begin taking advantage of new technology from both the application and transport perspective.

The Commission has asked public safety to provide information on the uses and types of technology that we will use if we have broadband wireless capability. We are experiencing unprecedented innovation in First Responder technology that will improve response times, enhance situational awareness and advance emergency medical care. Technological advancements are being made in the defense industry that are cascading down to public safety from gunshot detection to blue force tracking, but we will not be allowed to take full advantage of these improvement if we cannot push the technology to the front line First Responders. As our capabilities to gather data, information and intelligence grow we are inhibited by the lack of technology required to distribute this information. The City has quantified the applications and uses of a broadband wireless network to the degree possible. However, it is challenging to project how much spectrum will be required in the future due to the rapid development of new technology. The 700 MHz spectrum, specifically the "D" Block currently still being considered for auction, affords public safety the best near-term opportunity to bring public safety into the 21st century. The Commission should also ensure that the spectrum requirements are allocated to satisfy the present and future needs of public safety which in-turn will promulgate the development of the applications and devices by creating a viable consumer market.

We urge the Commission to analyze the information we have provided and afford the City the opportunity to utilize the 700 MHz spectrum to build a robust and resilient network that will satisfy our wireless requirements for now and the future. We must plan for the future, and allocate sufficient spectrum now, to enable the development of the mobile and wireless applications required to carry out our public safety mission.

Respectfully submitted,

/s/

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